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Development of Learning Devices Through Scientific Inquiry Model Based on Javanese Culture to Improve Students' Science Process Skill and Self-Efficacy

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Abstract

This study aimed to describe validity, practicality and effectiveness of learning devices through scientific inquiry model based on Javanese culture to improve students'science process skill and self-efficacy. This study was Research and Development (R & D) by using 4-D model included define, design, develop, and disseminate steps proposed by Thiagarajan. Learning devices developed were lesson plan, student worksheet, student workbook, teacher workbook and instrument of students' problem solving ability of physics problems related to temperature and heat. The subjects of this study were state senior high school 1 Tanjung Pura class X MIA. The result showed that learning devices using scientific inquiry model based on Javanese culture were valid, practical and effective and the students' science process skill increased with the average N-Gain at meeting I was 0, 29, at meeting II was 0,35 and at meeting III was 0,50 in medium level.

Keywords: Development, Learning Devices, Scientific Inquiry, Javanese Culture, Science Process Skill, Self-Efficacy

1. Introduction

Education and culture cannot be avoided in everyday life, because culture is a whole and comprehensive unity of society and education is fundamental need for individual. Butts, R.F (1955: 2) states that education is an activity of receiving and giving knowledge so that culture can be passed on from generation to generation. Education and culture have a very important role in growing and developing noble value of nation, which has an impact in the formation of characters based on noble cultural values. Soenarto in Widodo (2013: 142) states that culture is the manifestation of human character.

Combination of education and culture in learning process will create meaningful learning. Sardjiyo & Pannen (2005: 84) argues that cultural-based learning is a strategy to create learning environments and designing learning experiences that integrate with culture as part of the learning process. Cultural-based learning is based on the recognition of culture as fundamental and important part of education, as an expression and communication of idea and the development of knowledge, especially in physics.

Learning Physics based on culture not only transfers culture and cultural manifestation but also uses them to enable students to create meaning, thinking beyond the limits of imagination, and achieving a deep understanding of the subjects studied creatively. Moreover, nowadays implementation of curriculum 2013 as one of government effort to improve the quality of education.

Curriculum 2013 places culture as one of the components to develope from elementary to high school level. Muslich in Pratama et al (2015: 12) states that there are opportunities for regions and education practitioners to adapt, modify and contextualize curriculum based on reality in the field, both demographic, geographical, sociological, psychological and students'culture. This provides an opportunity to innovate pedagogic based on local wisdom, so students can learn according to their own tradition, and cannot be separated from culture in social system.

Curriculum 2013 is a curriculum based competency with constructivist learning. The implementation of curriculum based competency is determined by the ability of teacher to develop learning devices, namely the development of syllabus, textbooks, learning resources and media, instructional model, instrument of assessment, and implementation of lesson plan (Akbar, 2013: 2).

Based on the previous observations of researchers in State Senior High School 1 Tanjung Pura, it is found that teacher has not used the learning devices in accordance with the characteristics and culture of students. Teachers as educators only uses book from publishers and lesson plan that are monotonious designed by field teaching experience teacher, without using appropriate approaches of learning materials to be presented in the classroom.

The strategy of organizing and delivering materials with learning devices used is not well structured and less attractive to students. It causes difficulties for teachers to develop physics-oriented learning material in curriculum 2013. The reality in State Senior High School 1 Tanjung Pura, the process of learning physics are still dominated by product aspects not involves process aspects. In the process of learning physics, students rarely conduct experiments so the use of physics laboratories in schools is not optimal and scientific attitude competence and science process skills possessed by students have not been achieved.

Science process skill (SPS) is important for every student because the skill is used in everyday life to improve scientific ability, quality and standard of living. SPS also affects private, social, and individual life in global world. SPS has an effective competency to study science and technology, problem solving, individual and social development (Akinbobola, 2010). SPS emphasizes the formation of skills and communication to acquire knowledge, so to familiarize students to be physicists, they need to be provided with SPS.

Based on interview with some students randomly in the school, students say that they rarely use laboratory although the school has laboratory. This has an impact on students' SPS that has not developed because students rarely do practicum and poorly trained with SPS. When students do practicum, they look confused in following worksheet steps given by the teacher. Students are less able to observe the phenomenon occurs during the lab and to communicate with a group members, less serious, unable to make right conclusions and tend to ask the teacher in conducting experiments. Beside that, if students are accustomed with practicum, the students' SPS can increase as students are used to observing, asking, hypothesizing, predicting, finding patterns and relationships, communicating, designing and making, planning, conducting investigations, measuring and counting, as indicators of students SPS.

Students' SPS which has not developed due to poorly trained is also in line with the low cognitive learning outcomes of students. According to the data obtained from physics teacher documents, it can be seen that physics learning outcomes is low. The average score of physics exam of class X students is still low compared to minimum mastery criterion which is 75. Physics average score in 2013/2014 is 65 and in 2014/2015 is 67. This data indicates that the average physics score for both classes is low.

Students' SPS which has not develop also affects the students' self-confidence. This statement is supported by Ketelhut (2007) states that self-efficacy relates to students' SPS, students' self-efficacy increases due to the formation of heterogeneous groups. So when collecting data, students with low self-efficacy start to conduct investigations. According to Tansil (2009: 183), student who feels capable to do something has impacts on the students mastery to do things well. High learning outcomes have an impact to improve student self-efficacy, whereas failure to solve problems leads to low learning outcomes that reduced student self-efficacy.

According to Bandura (Somakim, 2010: 32), self-efficacy is one's consideration of himself to achieve performance levels desired which influences next action. It is the core of human beings who have a strong desire to develop their potential. Learning process requires high self-efficacy in order to be able to understand the concept of physics well. Through routine exercises in solving physics problems provides students' positive self-efficacy towards cognitive skills and good behavior.

The importance of the students 'self-efficacy is not the same with reality in the field that still low. This statement is reinforced by closed-scale questionnaire consists of 5 questions with choices strongly agree (SA), agree (A), disagree (D), strongly disagree (SD) given to 30 students of State Senior High School 1 Tanjung Pura class X3 Program Science. From questionnaire, it is obtained 53.33% of students feel not confident to do physics exam well. 40% of students enjoy physics learning. 56.67% of students are less interested in solving physics problems so unable to finish it then they tend to cheat the work of his friend. 56.67% students do not have strong desire to understand physics and tend to avoid physics. 60% students consider physics very useless to learn.

The problem above finally conical to the assessment that physics is difficult and not interesting. Students are less interested in learning physics. Students tend to be afraid to learn physics and stay away from physics teachers. Learning physical tends to be mathematical that make students bored.

To overcome the problems above, it is needed a model that involves students' active learning to improve SPS, students' learning outcomes and self-efficacy, ie scientific inquiry learning model. The scientific inquiry learning model is designed to engage students in genuine investigations by confronting them, helping students identify conceptual or methodological issues in the field, and invite students to be able to devise ways to solve the problem (Joyce et al. , 2009).

The scientific inquiry model is suitable to improve SPS because students are faced with a scientific activity through experiment. Students are trained to be skilled in obtaining and processing information through thinking activities by following scientific procedures such as observations and measurements, hypothesizing, predicting, finding patterns relationships and explaining findings. Students are directed to develop their own SPS to process and find the knowledge themselves. As students are usual to do the investigation, not only SPS that grows but also students' learning outcomes will increase because students have learned physics more meaningful, understood the process. Students' self-efficacy will also increase as the physics score can increase well.

Integrating scientific inquiry learning model and Javanese culture in learning process will create meaningful learning atmosphere and add score because students' self-efficacy character or attitude to solve physics problem also increase.

Based on the explanation above, this study aimed to: 1) produce valid, practical and effective learning devices based on Javanese culture using scientific inquiry model; 2) improving students' science process skills and self-efficacy of by using learning devices with scientific inquiry model based on Javanese culture.

2. Method

The study was Reseach and Development (R & D) research with 4-D model developed by Thiagarajan consisted of four steps: define, design, develop and disseminate. This study developed physics learning devices of senior high school students through scientific inquiry model based on Javanese culture related to temperature and heat. The products developed were lesson plan, student worksheet, student workbook, teacher work book , students' science process skills instruments and self-efficacy. The sampling technique was cluster random sampling. The trial of product usage was done twice, Trial I with 5 students of class XI MIA I and trial II with 35 students of class X MIA I. The instrument of data collection were validation sheet, observation sheet, and questionnaire. The validation sheet were used to collect the review result from the validator. Observation sheets were used to determine the learning implementation, assessing attitude's competence, skills, and activities. Questionnaires were used to obtain needs analysis and performance analysis data.

3. Result and Discussion

The result of this study was the product of learning devices through scientific inquiry model based on Javanese culture related to temperature and heat. The results of study were discussied as the following:

The define step was done to define the requirements in the learning process. This steps consisted of beginning-end analysis, student analysis, concept analysis, task analysis, and specifications of learning objectives. The results of beginning-end analysis concluded that it was required learning devices of scientific inquiry model based on Javanese culture in the development of learning devices. The result of student analysis obtained that students' academic ability was still low, the learning style of students who were active in group and the students' dominant tribe background of Javanese made the learning devices through scientific inquiry model based on Javanese culture were applied. Concept analysis was an analysis of the main concepts of the material being taught. The result of task analysis obtained refered to concept analysis and learning objectives based on core competence (CC) and basic competence (BC) which had been established in line with curriculum 2013.

Design step was done through preparation of test and nontest, format selection, media selection and initial design of learning device. The result of the tests arranged was a test of physics problem solving skills and non-test was questionnaire that showed students' learning independence. The result of format selection was adjusted to curriculum 2013, namely Permendikbud No. 103 year 2014. Furthermore, the format of student workbook (SW) referred to the rules of BSNP (National Education Standards Board) and the format of student worksheet was adapted to the steps of scientific inquiry model based on Javanese culture. The results of media selection or learning aids was visual media in form of Javanese culture pictures, traditional Javanese house, traditional clothes worn during wedding ceremony and kendil used to cooked liwet. The initial design results were lesson plan, teacher workbook, student workbook and student worksheet for 3 meetings, instrument of science process skill test and students' self-efficacy questionnaire. All devices at design steps were called draft I.

Develop steps aimed to modify and develop learning devices that had been made in previous stage of define and design. After the device was designed in form of draft I, then this steps tested validity by validator expert and field trials. The test of learning devices validation through PBL model based on Javanese culture in form lesson plan, student worksheet, teacher workbook and student book was done by validator expert consisted of lecturer and teacher.

Table 1. Experimental Validation Results

Learning Devices	**Average of Expert Validation**	**Category**
Lesson Plan	4.35	Good
Student Workbook	4.24	Good
Student Worksheet	4.47	Good
Teacher Workbook	4.50	Good

It can be concluded from table 1 that learning devices in draft I with various revisions had been used for trial. In addition, instrument of science-process skill test and student self-efficacy had been validated by experts and declared valid with various revisions. The design of learning devices that had been revised in draft I was called draft II. This learning devices were ready to use in the field. Field trials were conducted twice, namely trial I and trial II. These trials were conducted to determine the practicality and effectiveness of the learning devices developed. Learning devices were defined to be practical if there was an expert statement satated that devices were worthy to use and the implementation value of learning devices were good or very good (Nieveen, 2007; Akker, 2009; Herman 2012). While the effectiveness of learning tools seen from the classical students' learning completeness, student activities and responses given to learning devices (Nieveen, 2007; Akker, 2009; Herman 2012; Suyitno, et al., 2013; Slavin, 2006, Reiguluth, 2000).

Trial I of learning device used scientific inquiry model based on Javanese culture was conducted to 5 students of State Senior High School 1 Tanjung Pura class XI MIA I. Trial I was conducted by the researcher as teacher and two observers to observe the implementation of learning and student activities. The researcher has obtained the authorized agreement from experts to use learning devices in draft II. Furthermore, the learning implementation on trial I obtained an average of 2.82 and it was still in medium level (2 <≤ 3).

Classical Students' learning mastery in trial I that was 40%, where the limit of effective criterion fulfillment was 75% of students’ learning mastery (Herman, 2012). Student activity increased every meeting.

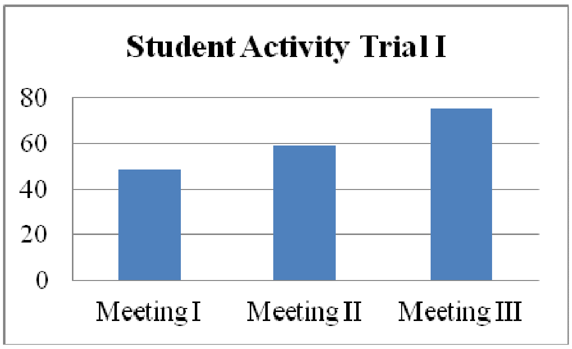

Figure 1. Student Activity Trial I

It can be concluded from Figure 1 that the average of student activity is still in medium level. Positive response of students to learning devices in trial I is 75.8% where the effectiveness limit is 80% of students gave a positive response.Based on the explanation above, it can be concluded that learning devices in draft II was not practical and effective so it needed revision based on analysis from trial I. The revised learning devices was called draft III. Draft III was the final draft that tried in trial II.

Trial II was conducted in State Senior High School 1 Tanjung Pura class X MIA I Tanjung consisted of 35 students. Trial II was conducted to measure draft III as learning devices used scientific inquiry model based on Javanese culture that fulfilled all specified practical and effective criteria. The result of trial II concluded that learning devices used scientific inquiry model based on Javanese culture developed had fulfilled all the practical and effective criteria. The practicality of learning devices as measured by their validity and implementation was better than trial I.

Table 2. Values of Learning Devices Implementation in Trial II

Average of Each Meeting			**Total Average**	**Category**
1	2	3		
4.13	4.48	4.80	4.47	**Very High**

The overall implementation of learning devices in trial II is 4.47, with reference to the learning devices implementation criteria, the average value is 4.47 in very high level ($4 < p \leqslant 5$).

The effectiveness of learning devices used scientific inquiry model based on Javanese culture development had fulfilled all the criteria established and can be said to be effective.

Table 3. Classical Students' Mastery in Trial II

Category	**Science Process Skill**	
	Total	**Percentage**
Mastering Learning	31	89%
Not Mastering Learning	4	11%
Total	35	100%

With reference to student's mastery criterion, that is at least 80%, it can be concluded that the score of science process skill posttest in trial II had fulfilled the effective criteria that is 89% of students had been mastered the classical mastery achievement . Furthermore, student activity used scientific inquiry model based on Javanese culture was done by observation.

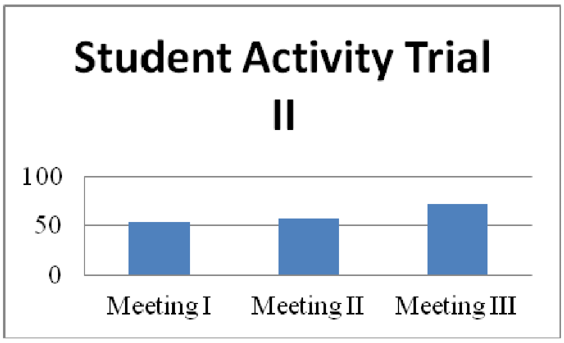

Figure 2. Student Activity Trial II

Overall, the average of student activity had increased. Thus, it can be concluded that learning devices used scientific inquiry model based on Javanese culture developed effectively in terms of the improvement of student activity.

The total average of student's positive response in trial II was 96.76%. with reference to criteria in chapter III, it can be concluded that the students' responses to the components of learning activities were positive. Based on the analysis in trial II, it was known that learning devices using scientific inquiry model based on Javanese culture had fulfilled all valid, practical and effective criteria. So there was no revision of draft III in the development of learning devices using scientific inquiry model based on Javanese culture related to temperature and heat after trial II.

Disseminate step was the final step in the 4-D development model. At this stage, learning devices that had been tried in the class will be re-tested by comparing the development of learning devices of experimental class with control class. However, this step was not carried out by researchers, due to time, cost and energy which were not discussed in depth.

Data obtained from posttest score of students' science process skill in trial II were analyzed to know the improvement of students' science process skill by comparing the average posttest score every meeting on trial II.

Table 4. N-gain of Students' Science Process Skills

Meeting	N-gain	Category
I	0.28	Low
II	0.36	Medium
III	0.45	Medium

Based on Table 4, the students 'science process skills at each meeting had increased so that it can be concluded that the implementation of learning devices using scientific inquiry model based on Javanese culture can improve students' science process skills.

Further, the improvement of students 'self-efficacy was obtained based on the increase of students' self-efficacy score in posttest and pretest which was assessed based on student self-efficacy indicators.

Table 5. Improvement of Self-Efficacy

No	Aspects of *Self-Efficacy*	Average per Indicator		Average of Improvement
		Pretest	Posttest	
1	Judgment of personal ability	16.88	18.84	1.96
2	Arranging mastery and skills	18.40	19.72	1.32
3	Discipline	16.64	18.28	1.64
4	Achievement	20.08	20.88	0.8
5	Motivation and Bussiness Prediction	18.60	19.76	1.16
6	Thought	17.56	18.25	0.69
7	Produce Achievement	18.8	19.56	0.76
Total Average of Indicators		**90.6**	**97.48**	
Total Average of Indicators' Improvement				**6.88**

Based on Table 5 above, it can be concluded that average of questionnaire score of student cooperation increased from pretest to posttest in trial II. The improvement of student self-efficacy in every aspect of indicators after applying learning devices using scientific inquiry model based on Javanese culture.

4. Conclusion and Suggestion

Based on the results of analysis and discussion, it can be concluded that: 1) The validity of learning devices using scientific inquiry model based on Javanese culture had been valid with the average of total validity Lesson Plan = 4.49, Student Workbook = 4.54, Teacher Workbook = 4.54, Student Worksheet = 4.57, instrument of science process skills test and questionnaires of self-efficacy had also been valid based on assessments of validators expert; 2) The practicality of learning devices using scientific inquiry model based on Javanese culture had been easy to use in learning based on the assessment of experts and observation in good category; 3) The effectiveness of learning devices using scientific inquiry model based on Javanese culture were effective to use in learning based on students' mastery had classically exceeded the minimum limit of 89% and student response had also been positive of 96.76%. 4) There was an improvement of students' science process skills after applying learning device using scientific inquiry model based on Javanese culture related to temperature and heat; And 5) There was an improvement of self-efficacy by applying the learning devices using scientific inquiry model based on Javanese culture 6.88 with very good category.

Based on the results and conclusion above, some suggestions can be given as the following: 1) Learning devices using scientific inquiry model based on Javanese culture has fulfilled the aspects of validity, practicality and effectiveness, it is suggested to teachers to be able to use this learning devices to develop science process skill and student self-efficacy; 2) Learning devices using scientific inquiry model based on Javanese culture can be disseminated, thus there are opportunities for other researchers to examine more about the effectiveness of learning devices And 3) Learning devices using scientific inquiry model based on Javanese culture can be used as a reference to make a learning devices about other material in order to grow students' science process skill and self-efficacy particularly in physics ability and generally in both same or different level of education unit.

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